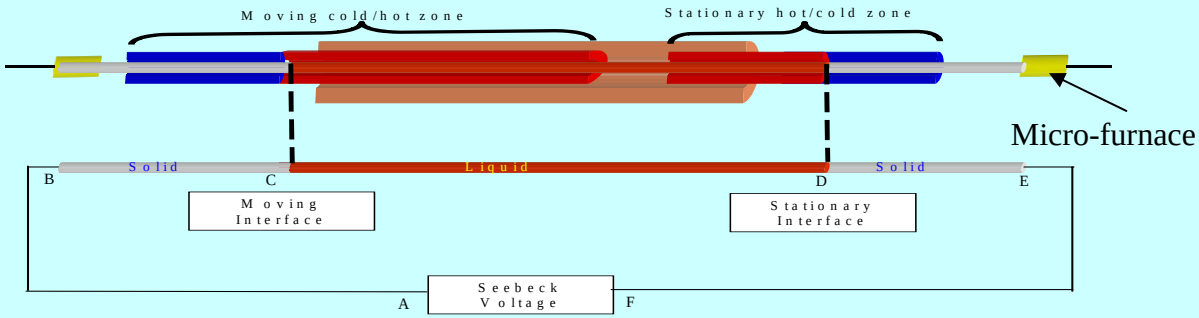
Melting Kinetics of Faceted and Non-faceted Crystals
Reza Abbaschian, University of Florida, DMR Award # 0314317

Objective

The main objective of the project program is to extend the scientific understanding of melting behavior of metals and alloys. The research will provide the critically needed data on the interface kinetics as a function of the solid-liquid interface superheating, melting rate, and composition.

Interface Temperature measurement

The emphasis of the research is on the accurate determination of the solid-liquid interface temperature during melting of single crystals. The interface temperature is measured directly using the Seebeck voltage difference generated across two solid/liquid interfaces; one stationary and the other moving. The experimental set up consists of three sets of furnaces and three constant temperature circulating baths and a translation system.



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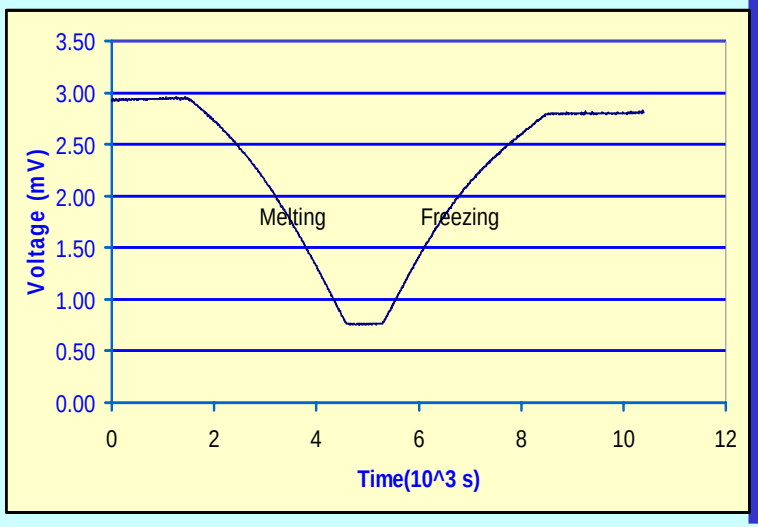
An important feature of the Seebeck technique is that it allows for a non-intrusive and continuous monitoring of the interface temperature. The following is an example of the Seebeck voltage generated during a melting and solidification cycle of Bi-1% Sn sample.



Broader Impact:

Melting is among the most common physical phenomena known to mankind, yet it has been the most difficult to understand. The development of melting kinetics laws, in addition to its scientific significance, is of great interest for a series of technical problems both during melting and solidification.

In addition, the project provides insight on the nature of solid and liquid interface, and whether both solidification and melting processes are governed by the same interfacial conditions. The recently published article (R. Abbaschian and W. Kurz: "Diffuse Solid-Liquid Interfaces and Solute Trapping," in Solidification Processes and Microstructures, Edited by M. Rappaz et al., TMS, 2004, 319) highlights the nature of solid /liquid interfaces.

The research also provides excellent opportunity for the education and training of graduate and undergraduate students. Presently, two graduate student and one undergraduate are involved in the program.

One Graduate student is supported by the Sloan Foundation fellowship.